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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/512,149	02/23/2000	Vishnu K. Agarwal	MI22-1322	3457

21567 7590 05/08/2002

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EXAMINER

PIZARRO CRESPO, MARCOS D

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 05/08/2002

21

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/512,149

Applicant(s)

AGARWAL, VISHNU K

Examiner

Marcos D. Pizarro-Crespo

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 04 April 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,4-16 and 56-62 ~~is~~ are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,4-16 and 56-62 ~~is~~ are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 18.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

Attorney's Docket Number: MI22-1322

Filing Date: 2/23/2000

Claimed Foreign Priority Date: none

Applicant(s): Agarwal

Examiner: Marcos D. Pizarro-Crespo

### **DETAILED ACTION**

This Office action responds to the amendment (paper no. 20) filed on 4/4/2002.

#### ***Acknowledgment***

1. The amendment (paper no. 20) filed on 4/4/2002 in response to the Office action (paper no. 17) mailed on 12/5/2001 has been entered. The present Office action (paper no. 21) is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1, 4-16, and 56-62.

#### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 4-11 and 13-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Ramakrishnan (US 5192871).

4. Ramakrishnan shows (see, e.g., fig. 2) all aspects of the instant invention including an integrated circuitry comprising a capacitor comprising:

➤ a first capacitor electrode **14**

- a second capacitor electrode **20**
- a high-K capacitor-dielectric region between the capacitor electrodes comprising:
  - a high-K substantially-amorphous-material layer **18**
  - a high-K substantially-crystalline-material layer **16** over the amorphous-material layer **18**

Ramakrishnan further shows that the crystalline-material layer and the amorphous-material layer may be made out of different chemical compositions (col.2/ll.46-50), and that the crystalline-material layer should be formed in a crystalline form (col.2/ll.38-40).

5. Regarding claim 4, Ramakrishnan shows at least one of the first and second electrodes comprising a metal (col.1/ll.60).

6. Regarding claims 5-9, 11, 13-15, Ramakrishnan's shows (see, e.g., fig. 2):

- the capacitor over a semiconductor substrate **12**
- the dielectric layer received between the first and second capacitor plates **14 20**
- the amorphous layer **18** contacting the first capacitor electrode **14**
- the crystalline layer **16** contacting the second capacitor electrode **20**
- the dielectric layer as the only capacitor dielectric region between the capacitor electrodes **14 20**
- the amorphous material layer **18** received between the semiconductor substrate **12** and the crystalline dielectric layer **16**

7. Regarding claims 10 and 56, Ramakrishnan discloses (col.2/ll.34-57) the amorphous dielectric material as completely amorphous (100% amorphous) so as to

prevent penetration of conductive foreign materials into the film, whereas the crystalline dielectric material should be completely crystalline (100% crystalline) so as to have the highest possible dielectric layer.

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 12 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramakrishnan, as applied to claim 1 above, and further in view of Graettinger (US 5844771).

10. Ramakrishnan shows most aspects of the instant invention but a capacitor wherein the semiconductor substrate comprises bulk monocrystalline silicon (see paragraphs 4-7 above). Graettinger teaches that in the processing of integrated circuits the substrate typically comprises monocrystalline silicon (col.1/ll.20-24).

It would have been obvious at the time of the invention to one of ordinary skill in the art to have the substrate of Ramakrishnan comprising monocrystalline silicon, as suggested by Graettinger, because in the processing of integrated circuits the substrate is typically monocrystalline silicon.

11. Claims 57-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramakrishnan in view of Howard (US 4437139).

12. Ramakrishnan shows most aspects of the instant invention (see paragraphs 4-7 above), except for an insulative layer between the substrate and the capacitor electrodes. Howard, on the other hand, suggests (col.3/ll.12-15) including a silicon-dioxide insulative-film between the substrate and the capacitor for isolating the capacitor therefrom.

Accordingly, it would have been obvious at the time of the invention to one of ordinary skill in the art at the time of the instant invention to include a silicon-dioxide insulative film between Ramakrishnan substrate and his capacitor, as suggested by Howard, in order to isolate the capacitor from the substrate.

13. Claims 60-62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramakrishnan in view of Eguchi (US 5442585) and Shrivastava (US 5557122).

14. Ramakrishnan shows most aspects of the instant invention (see paragraphs 4-7 above), except for the specific capacitor-dielectric thickness claimed by the applicants *i.e.*, an amorphous dielectric thickness of 20-250Å, a crystalline dielectric thickness of 20-90Å, and a capacitor-dielectric region of 40-500Å.

Ramakrishnan, however, shows that the crystalline-dielectric layer may have a thickness of 100Å (col.3/ll.44) and that the amorphous-dielectric layer should be as thin as possible in order to prevent degradation of the capacitor performance (col.4/ll.20-26). Although Ramakrishnan does not specify the same dielectric thickness as those claimed by the applicants, thickness differences are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes.

Shrivastava, for example, teaches that the capacitor-dielectric thickness is a design variable that if reduced will increase the capacitance of the capacitor (col.2/ll.59-63). Likewise, Eguchi teaches that in order to increase the capacitance of a capacitor, the thickness of the capacitor dielectric should be reduced; however, if the film is made too thin, the performance of the capacitor deteriorates (col.1/ll.44-48).

Accordingly, it would be an obvious matter of design choice to select a suitable thickness for the capacitor-dielectric layers of Ramakrishnan, as taught by Shrivastava and Eguchi, since the capacitor-dielectric thickness is variable of importance subject to routine experimentation and optimization and it is not inventive to discover the optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235. Furthermore, it appears that the dielectric-thickness differences between Ramakrishnan and the claimed invention produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416.

### ***Response to Arguments***

15. The applicant argues:

Claim 1 recites a high-K substantially crystalline material layer that is at least 70% crystalline. Ramakrishnan teaches (col.2/ll.35-39) that crystalline dielectric films have higher dielectric constants than amorphous or partially crystalline films of the same material. Ramakrishnan, however, is completely devoid of any teaching of a crystalline percentage for the crystalline films. Therefore, in no reasonable interpretation does Ramakrishnan teach or suggest a high-K substantially crystalline material layer that is at least 70% crystalline, as it is recited in claim 1.

The examiner responds:

Ramakrishnan clearly distinguishes (col.2/ll.36-38) between three different types of dielectric films: amorphous films, partially-crystalline films, and crystalline films. Typically, a crystalline film of a dielectric material will exhibit a higher dielectric-constant than its amorphous or partially-crystalline counterparts (col.2/ll.36-38). Consequently, it

is desirable to form the insulator layer **16** in a crystalline form (col.2/ll.38-40). In other words, the insulator layer **16** is not partially-crystalline, nor amorphous, but crystalline. Evidently, since Ramakrishnan clearly establishes that his crystalline materials are not partially-crystalline, nor amorphous, they must be completely crystalline, *i.e.*, 100% crystalline.

The open-ended numerical range in claim 1 specifying that the crystalline dielectric is at least 70% crystalline includes 100%-crystalline as a value within the range. Accordingly, Ramakrishnan clearly shows a crystalline dielectric layer that is at least 70% crystalline.

16. The applicant argues:

Claim 10 recites a high-K substantially amorphous material layer that is at least 98% amorphous. Ramakrishnan is completely devoid of any teaching to an amorphous percentage for the amorphous material, and therefore, in no reasonable interpretation does Ramakrishnan teaches or suggests that the amorphous-material layer is at least 98% amorphous.

The examiner responds:

There are several ways to state a percentage of a quantity. For example, a 50%-amorphous dielectric material can be described as a half-amorphous dielectric material without any further mention as to any percentage of amorphism. Similarly, a 100%-amorphous structure can be described as a 0%-crystalline material or simply as a non-crystalline material (Ramakrishnan/col.2/ll.57).

Ramakrishnan clearly distinguishes (col.2/ll.36-38) between three different types of dielectric films: amorphous films, partially-crystalline films, and crystalline films. Evidently, since Ramakrishnan clearly establishes that his amorphous materials are not



partially-crystalline, nor crystalline (col.2/ll.50-57), they must be completely amorphous, *i.e.*, 100% amorphous.

The open-ended numerical range in claim 10 specifying that the amorphous dielectric is at least 98% amorphous includes 100%-amorphous as a value within the range. Accordingly, Ramakrishnan clearly shows an amorphous dielectric layer that is at least 98% amorphous.

### ***Comments***

17. Applicant is advised that should claims 11 and 12 be found allowable, claims 15 and 16 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

### ***Conclusion***

18. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

19. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and an advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

20. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Art Unit 2814 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

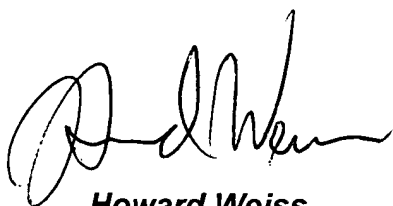
21. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Marcos D. Pizarro-Crespo** at **(703) 308-6558** and between the hours of 9:00 AM to 7:30 PM (Eastern Standard Time) Monday through Thursday or by e-mail via [Marcos.Pizarro@uspto.gov](mailto:Marcos.Pizarro@uspto.gov). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794.

22. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 308-0956**.

Art Unit: 2814

23. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass(es): 257/310, 438/240, 361/313	4/26/2002
Other Documentation:	
Electronic Database(s): EAST (USPAT, EPO, JPO)	4/26/2002



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MDP/mdp/  
4/26/2002